Understanding How Diffing Algorithm Works

Virtual DOM / Behind the JSX / Batch /

Reconciliation / That’s it.

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How Diffing Algorithm Works

Today's Topics

Why DOM Manipulating Is Expensive?

- Let's Not Do It.

Virtual DOM Came On The Scene

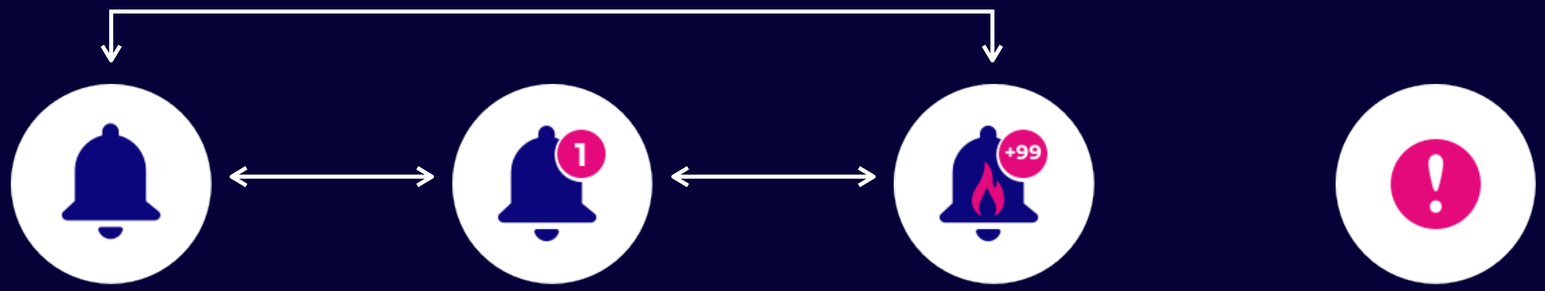
- Created to get rid of our headache.

React Reconciliation

- The real magic happens here.

DOM Manipulating In

Old Fashion



State Transition Complexity = O(N^2 -N)

DOM Manipulating Is Expensive

Let’s Not Do It

Let’s Not Do It

Every time the DOM changes, the browser has to do two intensive operations:

- **Reflow**

Re-Calculate the layout of a portion of the page or the whole page layout.

- **Repaint**

Visual or content changes to an element that does not affect the layout and other elements.

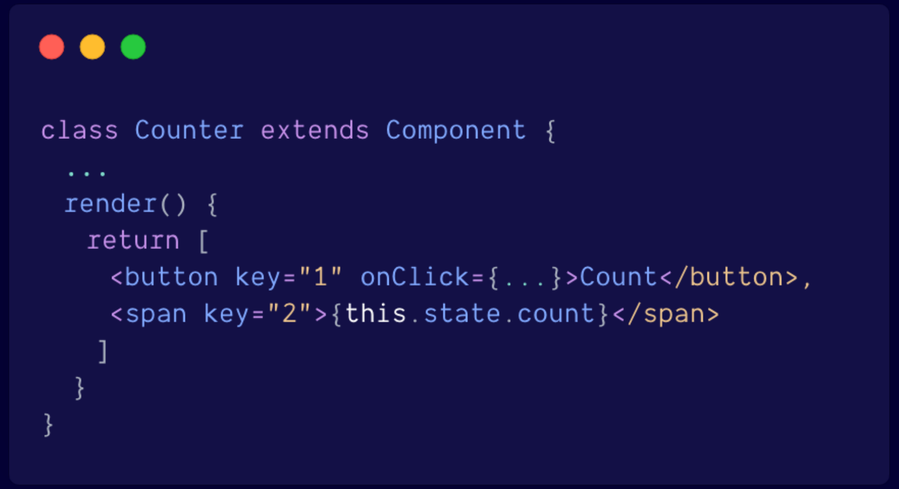
Virtual DOM

Rebuild The Whole DOM, For Every Change !

Sounds Expensive

Just A Regular Javascript Object

We can manipulate it freely and frequently without touching the actual DOM until ...



Fiber Nodes

Behind The JSX

```jsx
class Counter extends Component {
  ...
  render() {
    return [
      <button key="1" onClick={...}>Count</button>,
      <span key="2">{this.state.count}</span>
    ]
  }
}
```

```jsx
class Counter extends Component {
  ...
  render() {
    return [
      React.createElement(
        'button',
        {
          key: '1',
          onClick: this.onClick
        },
        'Count'
      ),
      React.createElement(
        'span',
        {
          key: '2'
        },
        this.state.count
      )
    ]
  }
}
```

Behind JSX

Browsers have no clue about JSX and its syntax. Browsers only understand plain JavaScript, so JSX will be transformed into something else.

Fiber Nodes Are The Result Of

Create Element

Create Element

<Button />

```
{
  $$typeof: Symbol(react.element),
  type: 'button',
  key: "1",
  props: {
    children: 'Count',
    onClick: () => { ... }
  }
  ...
}
```

```
{
  $$typeof: Symbol(react.element),
  type: 'span',
  key: "2",
  props: {
    children: '0',
  }
  ...
}
```

etc

We Can Think Of The Group Of These Object As Our Virtual DOM Tree.

Rebuilding The DOM

~~The Real Magic~~ Happens When We Wanna Update A Page
Important Part

Aka Reconciliation

Diffing Process

The process of **Updating** your **UI** to match your **Next** Application state

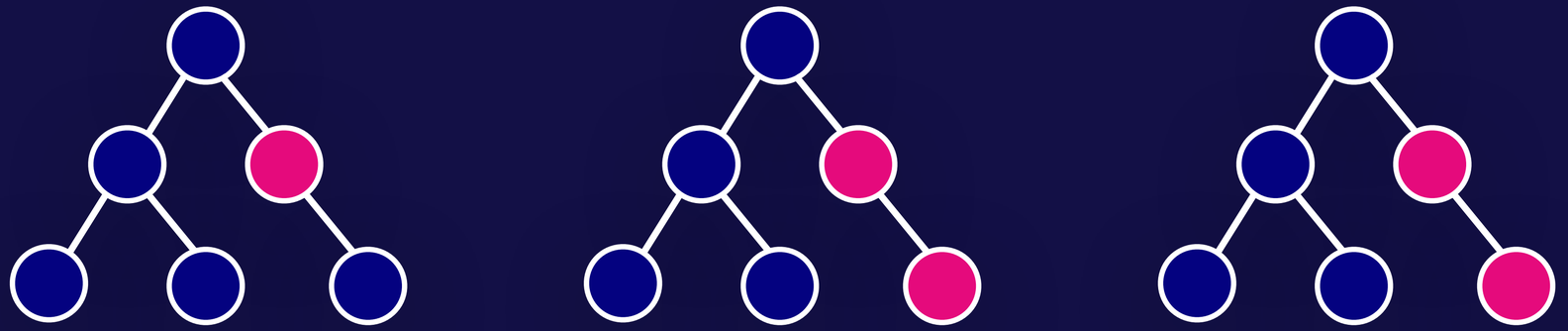
1. Work InProgress Tree

When React starts working on updates it builds a so-called **workInProgress** tree that reflects the future state to be flushed to the screen.

2. Reconciliation

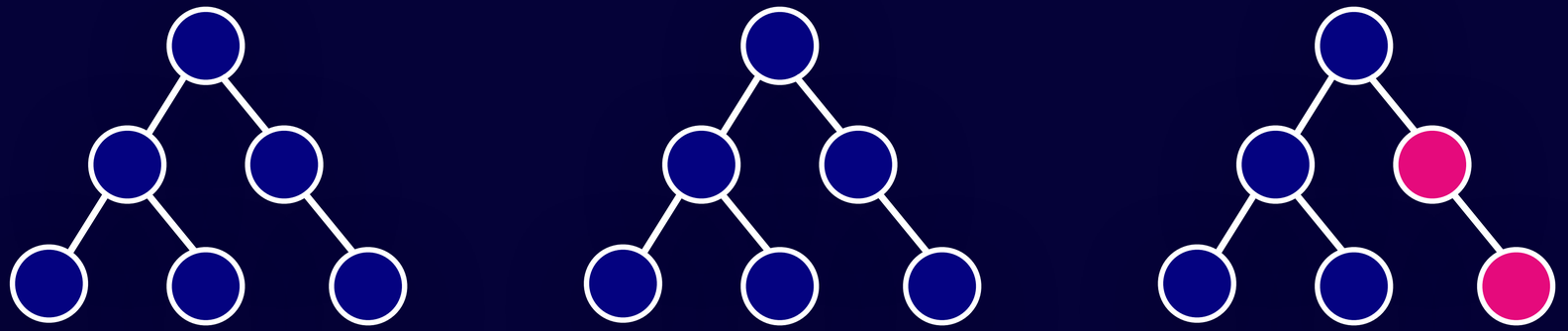
React will start comparing the **current** tree and **workInProgress** tree to determine which parts of the node tree have to be updated and which can be left untouched.

Virtual DOM



State Change → Compute Diff → Commit Changes

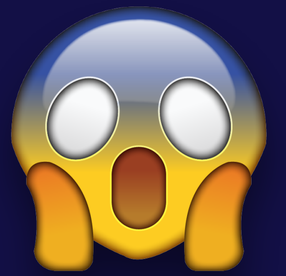
Browser DOM



React Complexity Diff

O(N)

Aka O(ok)



Truly Complexity Diff

O(N^3)

Aka O(no)

How Possible

How Possible

React relies on two assumptions to solve this problem in a linear time

1. Type

Two components of the same type will generate similar trees and vice versa.

2. Key

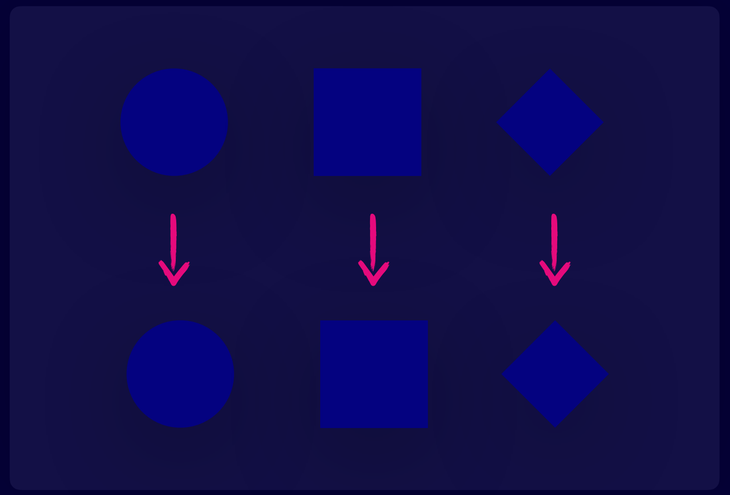
We are able to provide a unique key for elements that is stable across different renders.

Checking Type

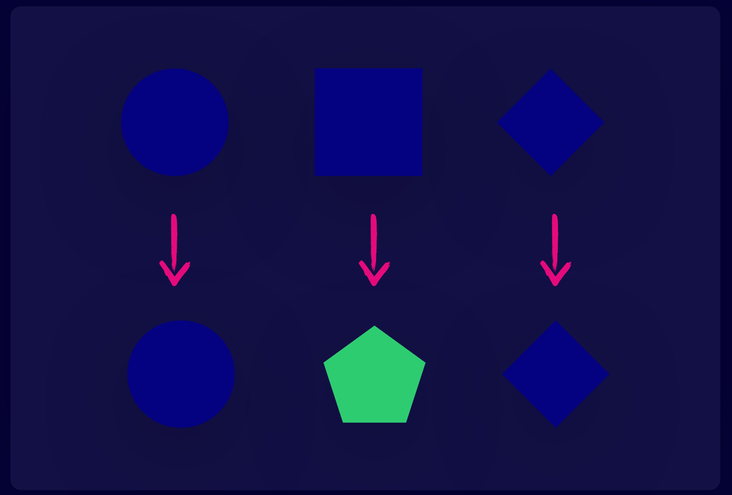
First Scenario

First Scenario

Same



Different



Checking Key

Second Scenario

Keys are about Identity in addition to Performance

Without Key

```
const CounterList = (props) => {
  return [
    <Counter />,
    <Counter />,
    <Counter />,
    <Counter />
  ];
}
```

New Item In 2nd Position

```
const CounterList = (props) => {
  return [
    <Counter />,
    <Counter />,
    <Counter />,
    <Counter />,
    <Counter />
  ];
}
```

Or

Remove Item In 2nd Position

```
const CounterList = (props) => {
  return [
    <Counter />,
    <Counter />,
    <Counter />
  ];
}
```

Checking Key

Second Scenario

Keys are about Identity in addition to Performance

With Key

```
const CounterList = (props) => {
  return [
    <Counter key="a" />,
    <Counter key="b" />,
    <Counter key="c" />,
    <Counter key="d" />
  ];
}
```

New Item In 2nd Position

```
const CounterList = (props) => {
  return [
    <Counter key="a" />,
    <Counter key="new" />,
    <Counter key="b" />,
    <Counter key="c" />,
    <Counter key="d" />
  ];
}
```

Or

Remove Item In 2nd Position

```
const CounterList = (props) => {
  return [
    <Counter key="a" />,
    <Counter key="c" />,
    <Counter key="d" />
  ];
}
```

Batched Updates

So The Repaint And Reflow The Browser Must Perform To

Render The Changes Are Executed Just **Once**

The End

Thank You. Ham3d Esmaili

God Bless | / @theham3d